Research into the porcellio scaber investigation

Porcellio Scaber are a species of Isopoda, they belong to the phylum Arthropoda and the class Crustacea thus meaning that they are closely related to crab, shrimp and lobster. As Crustacea, Porcellio Scaber do need to remain in moist environments such as compost heaps, under rotting wood and other dark places. Porcellio Scaber tend to behave in ways which are situated around water conservation and they need to avoid desiccation. This is because they are prone to desiccation because of their lack of a waterproof waxy cuticle on their exoskeleton. Porcellio Scaber have a large surface area to volume ratio and therefore are more likely to lose water by diffusion than other species. In the day light and in the cooler winter temperatures, Porcellio Scaber retreat deeper into their shelter making them very difficult to locate. However, at night they come out to feed and socialize thus making them nocturnal. Once uncovered, Porcellio Scaber will try and escape the light showing photo taxis. This means that they move away from bright conditions to darker conditions. When moving to darker areas Porcellio Scaber tend to congregate in clumps or groups to enhance survival, this movement decreases desiccation as Porcellio Scaber prefer cold and moist conditions. Porcellio Scaber have many natural predators these include shrews, hedgehogs, frogs, toads, lizards, owls and foxes, they respond to these predators by curling up in a ball they also have a special gland in their thorax that produces an unpleasant odor.

AIM

To investigate whether a range of light intensities will affect the distance traveled by slaters

HYPOTHESIS

The slaters rate of movement will be much greater when there is a higher light intensity compared with when there is a lower light intensity.

NULL HYPOTHESIS

The slaters rate of movement will not be affected by light intensity.

INDEPENDENT VARIABLE

In the experiment the independent variable is the light intensity. I changed the light intensity by placing different materials over the end of the lamp shade. This was done so that I could get an even range of light intensities which would make the results more accurate.

The final average light intensities are as followed:

1172. 8 Lux, 752. 7 Lux, 501. 9 Lux, 344. 7 Lux and 142. 3 Lux

DEPENDANT VARIABLE

The dependant variable depends on the independent variable. In this case the dependant variable is the slaters movement as that depends on the light intensity.

Note: I tested ten slaters for each of the five light intensities and I did this three times. To get my final distance traveled by the slaters I added the distance traveled for the same light intensities of each trial, I then divided this figure by three to get an average distance that a slater moved under this light intensity. (E. g. the highest light intensity figures were 103. 10cm (obtained from trial one), 109. 10cm (obtained from trial two) and 100. 95cm (obtained from trial three); I added this together and divided it by three to

get an average distance traveled when a slater was placed under the average light intensity of 1172. 8 Lux.

CONTROLLED VARIABLES

Collecting ten slaters for each of the different light intensities that are tested. This large sample size will ensure that results can be very correct as there is an accurate representation of the population.

Using the same size container is important when testing the slaters. This will ensure each slaters movement is tested under the same conditions and so the results gained from the tests can be far more accurate than if a different sized container was used during the tests. This also means that during each test, each slater will have the same amount of room to move.

I will make sure that the temperature and humidity are constant throughout trials. This can be done by taking the temperature (using a thermometer) and humidity (using a humidity meter) before and after each trial to see the range at which this changed, or if it changed. Doing the trials at the same time of the day means that these readings will be close together making results more accurate and eliminating error that could occur. It is important to keep the temperature and humidity the same at each trial otherwise slaters could behave differently varying the range in distances that they travel.

The time taken to track the slaters movement will be the same in each trial; one minute. This needs to be the same for each slater tested when placed at different light intensities. I made sure that this time was not to long so that

the distances would vary a lot, but not so short I can see a significant range between the distances traveled by the slaters at different light intensities.

I will make sure that the light positioned is exactly 5cm above the glass plate that lays above the slaters (when they are in the container exposed to different light intensities). This needs to be kept constant when changing all of the light intensities as it is not the independent variable. This fixed position means that the slaters are exposed to a range of light intensities rather than light intensities which are close together (which would occur when the height of the lamp changes). This makes results more reliable are there is a sufficient range between light intensities which shows how the distance traveled by a slater decreases as the light intensity decreases.

METHOD

Collect ten slaters that are of similar size and place them in a container with soil and bark obtained from their natural habitat.

Get a lamp and a light bulb (100W) and place the bulb in the lamp. Then tie a cord around the lamp so that it can be hung upside down (this will be tied to the roof.)

Next get a milk bottle and cut just above the handle as well as at the opposite end so that it is now 15cm in length, this will then be cello taped to the lamped to act as a ‘ lamp shade’.

Underneath the lamp will be a table with a glass top. This will be high enough to sit underneath to track the slaters movement.

Between the glass top of the table and the milk bottle will be a piece of glass so that heat is not filtered through to the slaters; only light is.

Begin by gathering equipment needed for the experiment [stopwatch, whiteboard pen, ruler, pen, toilet paper, paper, lux meter, thermometer, humidity meter, string and 10 slaters (for each test).]

Begin by hoping underneath the table with the whiteboard pen in hand, another person will close curtains and turn off all lights so that no other light influences the slaters movement.

The lamp will then be turned on to get a lux reading and the temperature and humidity will also be recorded, the lamp will then be turned off.

A slater will then be placed in the container by the person not under the table. They will then turn on the lamp (this is the first light intensity reading of 1172. 8 lux) and start the stopwatch at the same time and the person under the table will begin tracking the slater movement for one minute.

After one minute is up they will turn off the lamp and stop the stopwatch as well getting the slater out and placing it into a new container with soil and bark.

They can then turn on the bedroom light so that the person under the table is able to measure the distance traveled by the slater using string and a ruler. This will be recorded so that it can be compared with other distances traveled.

Toilet paper can then be used to wipe off the whiteboard pen from the glass.

Materials will then be added to the milk bottles base to get lower light intensity readings.

This method will then be repeated from steps 7-12 ten times using the same light intensity.

This method will then be repeated from steps 7-13 four more times using a range of light intensities (on average 752. 67 Lux, 501. 9 Lux, 344. 7 Lux and 142. 3 Lux).

This method will be repeated three times from steps 7-14. This gives a large sample size, providing sufficient data.

Once averages have been added together to get a final distance traveled at this light intensity the velocity can be calculated by using the formula velocity= distance/time.

FINAL RESULTS

Average light intensities

1172. 80 Lux

752. 67 Lux

501. 90 Lux

344. 70 Lux

142. 30 Lux

Average overall distance traveled by one slater

104. 38 cm

83. 51 cm

66. 60 cm

53. 27 cm

39. 68 cm

STATISTICAL ANALYSIS

The graph above of my results shows the relationship between light intensity and the slaters rate of movement. This in confirmed by the R^2 value of 0. 99853 which is very close to 1, indicating that 99. 9% of the variation results is explained by the change in light intensity. My R^2 value proves my results are accurate and that the rate of the slaters movement is a direct consequence of the changing light intensity.

CONCLUSION

I found out through my tests that the slaters rate of movement is much greater when there is a high light intensity. In comparison with when there is a low light intensity the slaters rate of movement is very minimal.

DISCUSSION

In my investigation I carried out tests to see whether the rate of movement changed when Porcellio Scaber (slaters) were placed under different light intensities and therefore if this affected their ecological niche. My results showed that slaters that were placed under the highest light intensity which had an average lux of 1172. 8 had the greatest rate of movement, travelling

an average distance of 104. 38cm. In contrast, slaters that were placed under the lowest light intensity of 142. 30 Lux travelled and an average distance of 39. 68cm in the one minute that they were tested for. Thus meaning that this light intensity is much more preferred than the other four higher light intensities as the environment is closer to their ecological niche. I found through statistical analysis (specifically the chi-squared test) I was able to reject my null hypothesis which was ‘ the slaters rate of movement will not be affected by light intensity’ and therefore I can accept my hypothesis which is what I thought would happen, this stated ‘ the slaters rate of movement will be much greater when there is a higher light intensity compared with when there is a lower light intensity’. The research I had done prior to the testing that I did showed that slaters preferred to live in moist areas which is why they are typically found in compost heaps, under rotting logs or wood and in other dark places. When uncovered or exposed to the light, slaters rate of movement will increase as they tend to move from bright conditions to dark conditions. Thus showing photo taxis, which is the orientation movement in which the direction of the movement depends on the direction of the stimulus; in this case light. When exposed to light that is of high intensity, slaters will increase their rate of movement as this is out of their preferred range of living. They will increase their rate of movement to avoid desiccation as they do not have a waterproof waxy cuticle on their exoskeleton like most other arthropods. Also when exposed to this high light intensity slaters show orthokinesis, which refers to an increase speed of movement and klinokinesis which refers to an increased rate of turning. In conclusion, slaters prefer light intensities which are similar to their ecological niche (represented by a low light intensity), thus enhancing their chance of

survival. If placed in areas with high light intensities slaters will respond by increasing their rate of movement (this meaning increasing their speed of movement as well as increasing their rate of turning.)

EVALUATION

My results are valid in this experiment because of all of the controlled variables that I used to keep the tests accurate. I made sure that I collected ten slaters for the light intensities that were tested, and for each trial that I did. This was done so that I could get an accurate average of the slaters movement for each light intensity tested (142. 30 Lux, 344. 70 Lux, 501. 90 Lux, 752. 67 Lux and 1172. 8 Lux.) To do this I will average the slaters movement from ten trials of the one light intensity, this will then be done for the other four light intensities. I will then repeat this method another two times so that I would have completed three trials in total with five light intensities tested in each. Having a large sample size means that I can get an accurate representation of the population. The same size slaters were used throughout the tests to ensure results are fair so that they can be compared to one in other. If the same size slaters were not used then the rate of movement would vary a lot and the distance traveled would have a wide range making the average not accurate. Having a larger surface area can also affect the slaters rate of movement which is again why the slaters size needs to be kept the same during the tests. It is hard to find slaters that are exactly the same size, so I chose slaters that were approximately 0. 5-0. 7cm as there seemed to be more that were around this size. I will make sure that the humidity and the temperature are constant throughout the test will once again make the results that much more accurate. This can be done by

using a thermometer and a humidity meter. Tests should be the same as the previous day. Keeping the temperature and humidity constant means that the slaters will be tested under the same conditions and there won't be any other variables affecting the slaters rate of movement. The time taken to test the slaters needs to be the same for each test, this will be one minute. This will be one minute from when the slater is placed in the container. The length of time that the slater is timed for should not be to long as the slaters can fatigue at different rates which would vary the distances traveled. All trials should be tested at one minute so that they can be compared to one in other. The lamp will be positioned exactly 5cm above the glass piece that lay above the container for all of the tests. To change the light intensity I placed different materials over the end of the milk bottle. If there was variation in the height of the lamp as well as the light intensity, the range of light intensity would vary too much for the results of the tests to be correct. My results are valid in this experiment as I repeated each light intensity three times, with ten slaters in each test. This means that their will be an accurate representation of the population by the large sample size tested. This also means that some figures can be slightly above or below the average as there is a large sample size to compensate for these numbers. After I had repeated each light intensity three times, I added these figures together and divided this by three to get the average distance traveled for that particular light intensity. This would minimize random error that could occur among these trials. By eliminating the effect of bias during the trials that I did I randomly chose slaters out of the container just after I collected them from the garden. Because I picked them from the garden knowing that they were all the same

size there was no need compare the size of them to other slaters or specific characteristics that would enhance the slaters rate of movement.

The first overall trials that I did I noticed that there were distances traveled by the slaters that were well out of the average. I decided to retest these figures to get a more accurate average. These figures that I retested are highlighted in a table in my logbook. Later I retyped the graph with the new figures that had been calculated.

Using the Chi-Squared test I found that using the final averages of distance traveled by the slaters resulted in an x^2 value of ∑37. 05. On the x^2 table with four degrees of freedom the calculated value for x^2 of 37. 05 corresponds to a probability off the graph towards the right (as seen in page 39 of the 2011 BioZone) meaning that by chance a value of 37. 05 would only occur greater than 0. 001% of the time. Because the value of 37. 05 is far greater than the tabulated value for P= 0. 05, I would reject the null hypothesis and accept my hypothesis. Thus therefore backing up my tests and the research I had done concluding that my results are valid.

For below using the Chi-Squared test:

E= the expected result

O= the observed result

∑= the sum of

Category

O

E

O-E

$(O-E)^2$

$(O-E)^2/E$

1172. 8 Lux

104. 38

69. 488

34. 892

1217. 45

17. 52

752. 67 Lux

83. 51

69. 488

14. 022

196. 62

2. 83

501. 90Lux

66. 60

69. 488

-2. 888

8. 34

0. 120

344. 70 Lux

53. 27

69. 488

-16. 218

2. 63. 02

3. 79

142. 30 Lux

39. 68

69. 488

-29. 805

888. 34

12. 79

$$\sum = 37.05$$

Overall the tests went according to plan, my hypothesis was correct and the research I had done backed up the results of the tests. Eliminating the effect of bias and having controlled variables ensured that the tests that I did were as accurate as possible.